Vegetative Buffer Regulations to Protect Water quality

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Vegetative Buffer - *Definition*

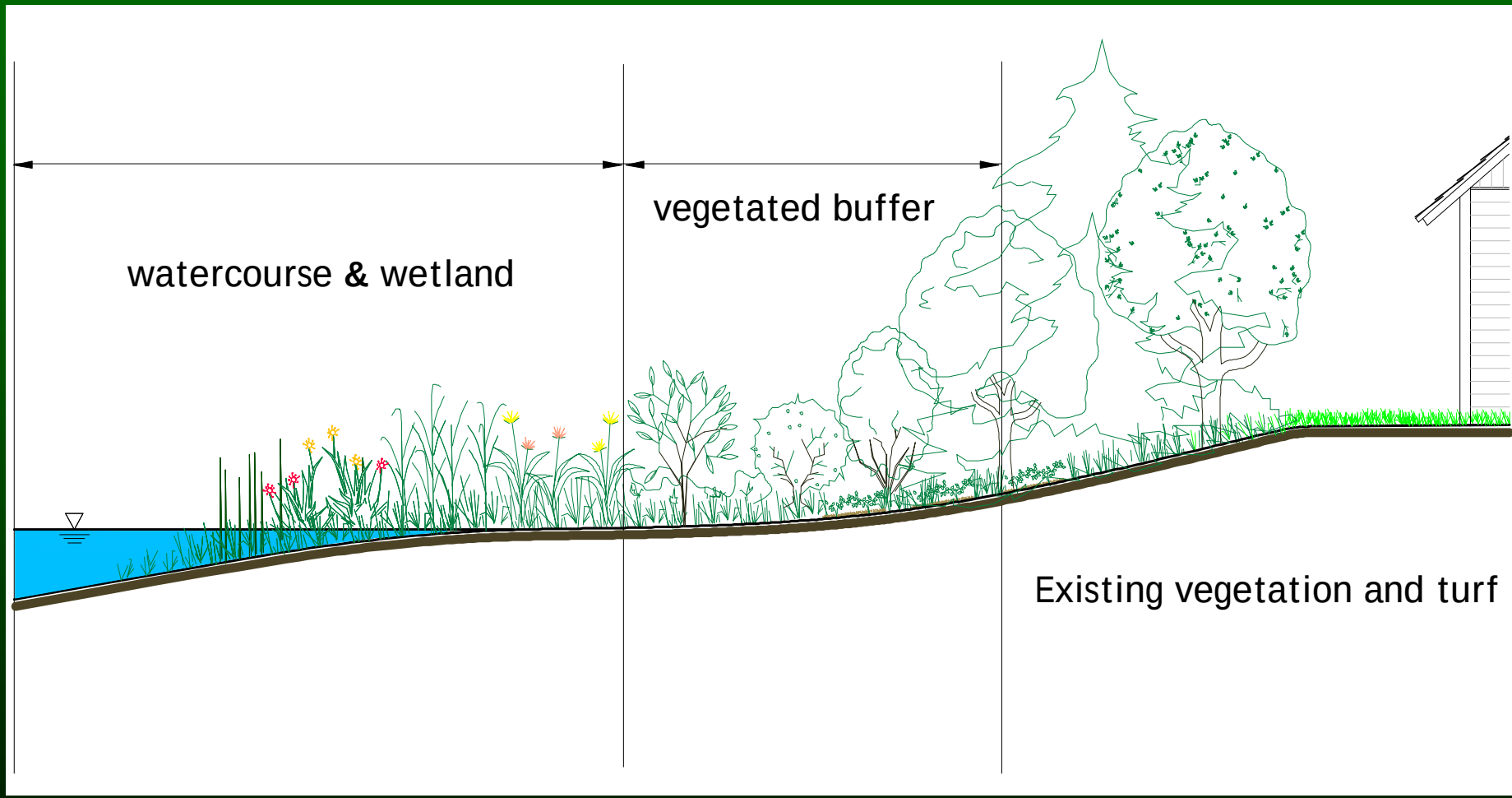
Form:

Typically defined as a vegetative upland area (determined by soils, topography and vegetation) directly adjacent to a wetland or watercourse with ecological, hydrologic and physical connections to the wetland or watercourse.

Function:

Functional entity used to treat stormwater runoff, and enhance/protect/ preserve water quality.

Vegetated Buffer



Vegetated Buffer shown – native planted strip between wetland/watercourse and upland existing vegetation

Summary of 169 Municipal Regulations *"Regulated Areas"*

- Not all communities have setbacks cited in their regulations
- Setback distances cover a broad range of distances, variables (slope angle, land use)
- Some communities use resource specific setbacks (river, watershed, floodplain)
- None cite a methodology for determining "buffer" width

Buffer Observations

1) Local Buffer regulations don't consider individual buffer functions or the characteristics or condition of the buffer

2) Buffer size is either "fixed" or "variable"

Fixed width – easily enforced, existing and proposed conditions not considered

Variable width - Considers site specific conditions, trained staff, variability

Vegetative Buffer Water Quality Functions

1. Sediment removal (phys. filtration)
2. Nutrient removal (plant uptake & soil adsorption)
3. Stormwater runoff (filtration & infiltration)
4. Water temperature moderation

Buffer Sizing and Design

General Considerations - “one size does not fit all”

1. Objectives must be defined
2. Watershed position
3. Existing plant composition and density
4. Soils and slope conditions (above & within buffer area)

Buffer Sizing and Design

Objectives vs Proposed Land Use

1. Non-disturbance zone – “buffer”
2. Stormwater runoff treatment
3. Sediment removal
4. Habitat enhancement
5. Wildlife (corridor, forage, breeding)
6. All of the above

Buffer Sizing and Design

Watershed position

1. Position does impact effectiveness
2. Buffering low order streams (1st-3rd), greater impact on water quality than wider buffers on large order streams – sediment source control

Buffer Sizing and Design

Existing plant composition and density

- Inventory existing species & density
- Use “undisturbed” riparian community as guide for enhancement/management
- Ground cover critical element
- Microtopgraphy within buffer area may permit channeling of surface flow

Buffer Sizing and Design

Soils and Slope:

- Placement of well developed vegetative buffer strip (VBS) between erosive soils or soils exposed for extend periods
- Reduce runoff velocity, thus reducing scour potential & sediment movement
- Promotes sheet flow/infiltration

Buffer Size: Recommend Width for Water Quality

1. Sweeney (1992) modified Welsch (1991)

   "Three Zone"

   - fixed width Three Zone method for riparian forest restoration

2. Westchester Environmental Management Council Method

   - considers slope

Welsch (1991) "Three Zone Method"

Zone	Width	Purpose
Zone #1- Trees	T.O.B to 5-8 m (15-25 ft) landward	Bank stabilization, moderate water temperature, promote algal growth, woody debris input, nutrient & detritus processing
Zone #2 – Trees & Shrubs	Landward edge of zone #1 to 3 to >100 m (10 - 200 ft)	Long-term sequestering of nutrients, sediments, and other pollutants, runoff infiltration
Zone #3- Grass or Herbaceous	Upland edge of #2 to 3 meters if used with zones 1 & 2, or 10.6 m (35 ft) alone.	Slow runoff, filter sediment promote infiltration, nutrient uptake, and sheet flow

(after Welsch, 1991)

Sweeney (1992) Modified Three Zone Method

Zone	Width	Purpose
Zone #1- Trees	T.O.B to 4.6 m (15 ft) landward	Bank stabilization, moderate water temperature, promote algal growth, woody debris input,nutrient & detritus processing
Zone #2 – Trees & Shrubs	Landward edge of zone #1 to 18 m (60 ft)	Long-term sequestering of nutrients, sediments, and other pollutants, runoff infiltration
Zone #3- Grass or Herbaceous	Upland edge of zone #2 to 6.1 m (20 ft) landward	Slow runoff, filter sediment promote infiltration, nutrient uptake, and sheet flow

(after Sweeney, 1992)

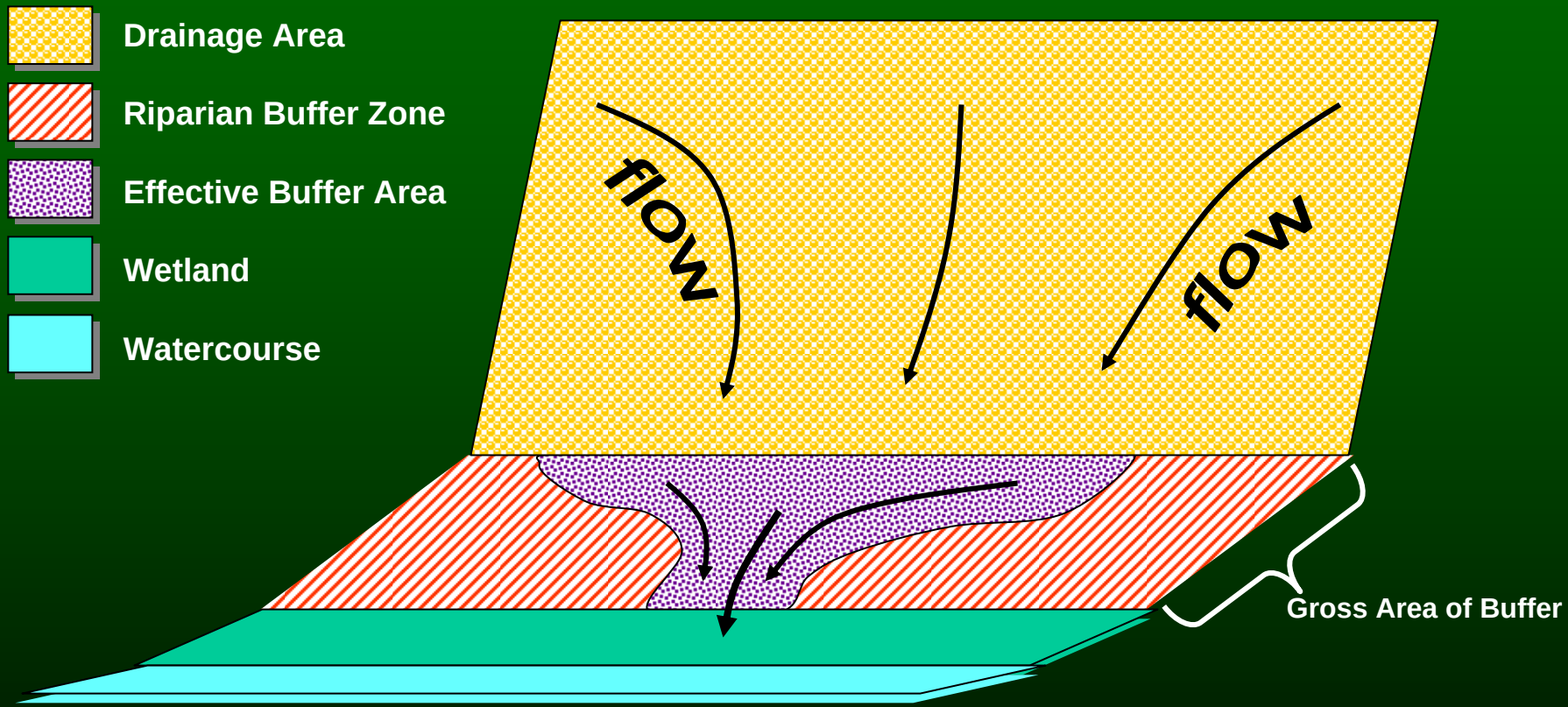
Westchester County Method (1981)

- Minimum starting buffer width of 7.6 m (25 ft)
- Increase buffer width by 0.9 meters (3.0 ft) for each percent (%) increase in slope
- Reduce buffer width by 0.1 meters (1.0 ft) for each 0.9 meter (3 ft) of adjacent brush or woodland growth in good hydrologic condition
- Slopes >15% and/or slope runs > 200 ft and/or if filter is in dense shade or subject to heavy traffic, then temporary E&S controls and level spreader required

Selecting Buffer Widths: *Additional Methods*

- Connecticut Guidelines for Sediment and Erosion Control 2002 (50 ft to >1600 ft, 10% max. slope) – ***Stand alone control***
- Finley (1987) 15m (49 ft) starting width, increase 6m (19.7 ft) for each 5% increase in slope to a maximum slope of 25% and 150 feet width

Effective Buffer Area

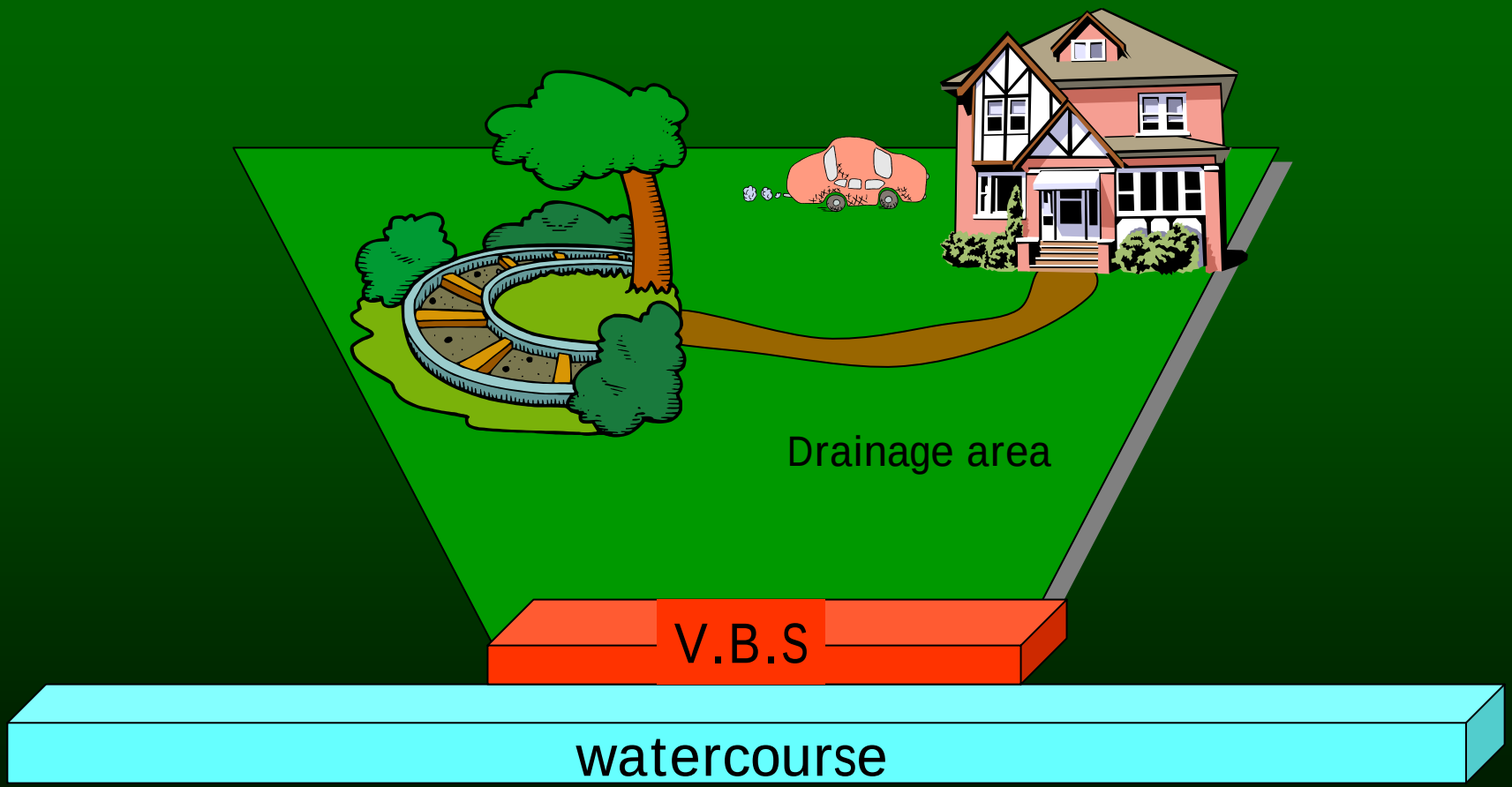


Modified after Dossky et al. 2002

Physical Environment

- Soil Type – Drainage class/hydrologic group, erodibility index
- Topography – Greater the slope, faster the runoff, increase in soil erosion and sediment transport potential
- “Area Ratio” - size of the drainage area contributing flow to the buffer, smaller the ratio, better the treatment

Area Ratio



Buffer Size: *Recommend Width for Water Quality*

- Observations from the literature reviewed:
- Width of VBS range between 2 - 500 meters (6.5 – 1,640 feet)
- Majority fall within 4.6 – 15 meters (15 – 49 feet)
- Slope of buffer >10%, increase in width
- Area ratio range 15:1 to 5:1 or less
- Plant species composition affects efficiency

Buffer Size: *Recommend Width for Water Quality*

Plant Composition:

1. Grass – effective in removing coarse sediment and absorbing nutrients
2. Shrubs – maintain soil infiltration capacity
3. Combined grass and shrub filter - more effective than grass alone
4. Ideal VBS is transition - grass, shrubs and trees

Removal Efficiencies – 15 - 30 ft Wide

Pollutant	Percent Removal	Buffer Type
Nitrate	61 – 92 %	Grass
Total P	72/93 %	Grass/Combined
Ortho-P	44/85 %	Grass/Combined

Plant Type vs. Removal Efficiency

Function	Grass	Shrubs	Trees
Sediment Trapping	High	Medium	Low
Filtration of Sediment Borne Nutrients, Microbes & Pesticides	High	Low	Low
Soluble Nutrients & Pesticides Removal	Medium	Low	Medium

Mod. after Fisher & Fischenich, 2000

Plant Species, Numbers & Sizing

- Diversity of plant species within the buffer insures better success in response to variable environmental conditions (temp., herbivory and water levels)
- Mixture of native herbaceous, shrub and tree species appropriate to the environment
- Habitat Diversity – variable amounts and types of plants, over microtopography

Plant Species, Numbers & Sizing

Tree Diversity

Number of Trees Planted	Max. % of any one species
10-19	50%
20 - 39	33%
40 or more	25%

•Fisher and Fischenich, 2000)

Plant Species, Numbers & Sizing

Tree Planting Densities:

- 400/acre, 10” to 48” tall
- 200/acre, 15 ft tall
- 3 - 5 ft tall saplings spaced 15 feet on center may reduce negative impacts of browse, better survival- ***Protection***
- Shrub planting – 2-3 feet tall, 5-8 feet on center - ***Protection***

Observations & Recommendations

1. Vegetative buffer strips (VBS) are an effective BMP in urban and agricultural settings
2. One-size does not fit all, bigger may not be better due to channelized flow
3. Vegetation provides E&S control, non-point nutrient and pollutant removal, promotes infiltration

Observations & Recommendations

4. Buffer Effectiveness dependent upon:
   a) Species and density of vegetation within the buffer
   b) Soil type above and within the buffer
   c) Slope of the buffer and contributing watershed area – microtopgraphy
   d) Length of the buffer (width of flow path) and Area Ratio
   e) Proposed land use above the buffer

Observations & Recommendations

5. VBS can be used as stand alone BMP, but are more effective when used in combination with other BMPs/LIDs
6. Long continuous buffer strip rather than segmented, can be variable in width depending on site conditions and design goals

Observations & Recommendations

7. Combination of grass, shrub & trees in sequence more effective in removing sediment, adsorbing nutrients, other NPS pollutants and maintaining soil infiltration
8. Native species should be used to enhance or create VBS in combination with long-term management plan.

Observations & Recommendations

9. Infiltration is key to reducing sediment and adsorbing pollutants
10. Smaller area ratios (5:1) are more effective in sustaining filtering efficiency of VBS
11. Buffer widths – 5m (16ft) to 15m (49ft) effective in reducing sediment loads and protecting water quality

Observations & Recommendations

12. In Urban/agricultural areas with slopes of <10% with limited area, 5m wide grass VBS are effective in removing significant amounts of NPS pollutants
13. In watersheds under development with slopes 10% or less and typical soil transitions, a minimum buffer of 10m (33 ft) can be effective.

Observations & Recommendations

14. With slope conditions >10% and:
    - wetlands & watercourses with moderate to high functional values or critical habitats (bogs, fens, wetland complexes)
    - or where water quality is a critical issues (public water supply watershed or impaired watercourse)

A minimum buffer of 10m + (50 ft or greater) should be considered with BMPs

Observations & Recommendations

15. Functional goals of the Vegetative Buffer Strip must be clearly defined and a management plan prepared to establish and maintain those functional goals both during and after development

Grass - Shrub Vegetative Filter

Additional Information

- CAWS web address:

  www.ctwetlands.org

  CAWS White Paper

- My email address:
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